ATTACHMENT 2

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of Petition of USTelecom for Forbearance Pursuant to 47 U.S.C. § 160(c) to Accelerate Investment in Broadband and Next-Generation Networks	))))))	WC Docket No. 18-141

DECLARATION OF WILLIAM P. ZARAKAS

I. Introduction

1. My name is William P. Zarakas. I am a Principal with The Brattle Group, an economics consulting firm, where I work primarily on economic and regulatory matters concerning the communications and energy industries. I have been involved in the economic analysis of issues facing these industries for roughly 30 years. I have provided reports and/or testimony before the Federal Communications Commission (FCC), the Federal Energy Regulatory Commission (FERC), the Securities and Exchange Commission (SEC), the Copyright Royalty Judges (Library of Congress), the U.S. Congress, state regulatory agencies, arbitration panels, foreign governments, and courts of law. I have previously provided testimony to the FCC on a range of issues and proceedings, including the economics and feasibility of deploying broadband networks and competitive analysis with respect to the market for business service data (BDS), market share and churn analyses, cost models, foreclosure and bargaining models, and pole attachments matters. My CV is attached as **Attachment A**.

2. I understand that USTelecom has petitioned the Federal Communications Commission ("FCC") to forbear from applying the unbundling, resale, and non-discrimination obligations included in Section 251 of the Communications Act ("Act"). Forbearance from Section 251 obligations would mean that competitive local exchange carriers ("CLECs")

would not have access to unbundled network elements ("UNEs") and/or services (that they can resell) from incumbent local exchange carriers ("ILECs") at rates prescribed by state regulatory commissions following the pricing methodologies set forth by the FCC when it implemented the Act. USTelecom represents that the telecommunications market in the U.S. should be considered to be competitive on a nationwide basis and, accordingly, ILECs should no longer be obligated to provide access to their networks at regulated rates. However, should competition be less intense or less ubiquitous than USTelecom asserts, forbearing from Section 251 could instead slow the deployment of broadband infrastructure and, in many geographic markets, impede consumer access to broadband.

3. I have been asked by Counsel for INCOMPAS to use available data to assess whether or not CLECs have, in fact, used UNEs as "stepping stones" in building out their own broadband facilities. Counsel also requested that I examine the benefits that CLECs have provided to consumers (in terms of speed and price) when they use UNEs as components in providing broadband service.

4. I analyzed the business models and service offering for three INCOMPAS member CLECs, together with the scope of facilities that are in place in the census blocks where they currently operate. INCOMPAS has indicated that Mammoth Networks ("Mammoth") (operating in the western U.S.),[1] Socket Telecom, LLC ("Socket") (operating in rural Missouri), and Sonic Telecom, LLC ("Sonic") (operating in California) are representative of its member CLECs.[2] Together, Mammoth, Socket and Sonic provide broadband and other telecommunications services in 24,737 census blocks.[3] I used data available from the FCC,[4] to determine the degree of facilities-based competition in these locations and to

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1 Specifically in the former U.S. West states (now part of CenturyLink).

2 Mammoth and Socket serve mainly rural areas, while Sonic provides service in urban and suburban California. Socket and Sonic serve a primarily residential customer base, while Mammoth also has a sizable business customer base. Finally, Sonic is one of the larger CLECs that provides service to mass market customers, while Socket and Mammoth are notably smaller.

3 This analysis does not include any census blocks where the CLECs offer services that are not required to be reported on FCC Form 477.

4 Fixed Broadband Deployment Data from FCC Form 477. Per the FCC: all facilities-based broadband providers are required to file data with the FCC twice a year (Form 477) on where they offer Internet access service at speeds exceeding 200 kbps in at least one direction. Fixed providers file lists of census blocks in which they can or do offer service to at least one location within the census block. The most recent dataset available at this time represents the status of broadband deployment as of the end of 2016 (December 2016 v1 dataset).

determine the extent to which the fiber networks have been deployed (by ILECs, CLECs or others). I also examined the largest CLEC in this panel, Sonic, in additional detail. (By itself, Sonic provides service in over 80% of the subject census blocks). I compared Sonic's fiber deployments to fiber build-outs by the ILECs (mainly, AT&T) that operate in the same census blocks as Sonic. I also compared Sonic's broadband over copper product offerings with those offered by the ILEC; that is, a comparison of what each offers consumers using the same copper-based facilities, in terms of speed and price.

II. UNE-based CLECs have deployed more fiber in the census blocks where they provide service than the ILECs have.

5. Table 1 summarizes the copper and fiber network options available in the 24,737 census blocks under study. The table indicates that, as expected, the ILEC copper network is ubiquitously present. In addition, the table indicates that, at the end of 2016, CLECs had fiber in place in 8% of the census blocks (2,081 out of 24,737 blocks), while the ILECs trailed, having deployed fiber in 1,595 (6%) of the subject census blocks.

Table 1: Scope of Telecommunications Facilities by Number of Census Blocks (Dec. 2016)

	ILEC		CLEC	Cable	Total
	Copper	Fiber	Fiber	Fiber	
Mammoth	61	8	46	1	69
Socket	3,933	677	698	115	4,402
Sonic	19,771	910	1,337	198	20,266
Total	23,765	1,595	2,081	314	24,737

Notes and sources:
FCC Form 477 data, December 2016 v1. Analysis by The Brattle Group.
The sum of census blocks for a given carrier may exceed the total census blocks under study; e.g., the ILEC may offer both fiber and copper based services in a single census block.

6. shows that the CLECs provide broadband over bare copper UNEs in 97% of the subject census blocks (22,656 with only UNE service and 1,352 with both UNE and fiber service, out of 24,737 blocks) – which provides a method for them to build the customer base necessary for them to fund their fiber networks. However, and importantly, as shown

above, CLECs are migrating from UNE-based services to full facilities-based services by actively deploying fiber, more so than have the ILECs.

7. Table 2 shows that the CLECs provide broadband over bare copper UNEs in 97% of the subject census blocks (22,656 with only UNE service and 1,352 with both UNE and fiber service, out of 24,737 blocks) – which provides a method for them to build the customer base necessary for them to fund their fiber networks. However, and importantly, as shown above, CLECs are migrating from UNE-based services to full facilities-based services by actively deploying fiber, more so than have the ILECs.

Table 2: CLEC Service Provision by Number of Census Blocks (Dec. 2016)

	UNEs Only		CLEC Fiber Only		Both		Total
Mammoth	23	33%	45	65%	1	1%	69
Socket	3,704	84%	342	8%	356	8%	4,402
Sonic	18,929	93%	342	2%	995	5%	20,266
Total	22,656	92%	729	3%	1,352	5%	24,737

Notes and sources:
FCC Form 477 data, December 2016 v1. Analysis by The Brattle Group.

8. shows that the CLECs provide broadband over bare copper UNEs in 97% of the subject census blocks (22,656 with only UNE service and 1,352 with both UNE and fiber service, out of 24,737 blocks) – which provides a method for them to build the customer base necessary for them to fund their fiber networks. However, and importantly, as shown above, CLECs are migrating from UNE-based services to full facilities-based services by actively deploying fiber, more so than have the ILECs.

9. Table 2 also shows that the smallest CLEC reviewed, Mammoth, to date provides broadband over its own fiber network in 66% of the census blocks in which it provides service. Socket, a broadband provider in rural Missouri, has already deployed fiber in 16% of its census blocks. In terms of sheer scope of investment, Sonic, the largest CLEC reviewed, has built out fiber to over 1,300 census blocks, and has deployed more fiber since then.

III. CLECs use UNEs as a stepping stone to build-out their own fiber facilities.

10. I assessed whether or not CLECs use UNEs as an interim step in building-out their own networks, as intended by the Act, by examining Sonic's business model and network evolution. Sonic is a comparatively large CLEC, providing internet access and voice services primarily to residential customers in California.[5] Sonic provides its reported services over its own fiber network and through a combination of bare copper UNEs and Sonic digital subscriber line (DSL) equipment.[6] Sonic also utilizes UNE dark fiber transport to connect its network.[7]

11. Table 3 provides a breakdown of the facilities in place across the census blocks in which Sonic operates. There is only one full facilities-based provider (i.e., the ILEC) in 2.7% of the subject census blocks, and only two full facilities-based providers in 91.0% of the census blocks under study.[8] Three full facilities-based providers are in the 1,281 census blocks where Sonic has built-out its own fiber network.[9]

Table 3: Summary of Underlying Loop Facilities in Census Blocks where Sonic Operates (as of Dec. 2016)

	Number of Blocks	Percent of Total
ILEC Facilities Only (copper and fiber)	549	2.7%
ILEC + Cable Facilities	18,380	90.7%
ILEC + Sonic Facilities (no cable)	56	0.3%
ILEC + Cable + Sonic Facilities	1,281	6.3%
Total Census Blocks	20,266	100.0%

Notes and sources: FCC Form 477 data, December 2016 v1. Analysis by The Brattle Group.

5 Roughly 88% of Sonic's customers are residential, 9% are small business, and 3% are enterprise customers.
6 Declaration of Dane Jasper ¶ 4 ("Sonic Decl."), attached to Comments of Sonic Telecom, LLC, WC Docket No. 18-141 (filed Aug. 6, 2018).
7 Sonic Decl. ¶ 7.
8 In most cases, the two providers consist of the ILEC and the cable company (18,380 census blocks. However, there are several census blocks in which the ILEC and Sonic both have facilities in place, while there are no cable facilities present (56 census blocks).
9 There are 1,186 census blocks where Sonic alone has fiber facilities in place plus 95 blocks where both Sonic and the ILEC have deployed fiber.

12. Table 4 provides a breakdown of the carriers that advertise broadband services to consumers in the subject 20,266 census blocks at maximum speeds of 25 Mbps (download) / 3 Mbps (upload) or greater. As shown in the table, Sonic is the only provider that offers internet service to consumers at these speed levels in all 20,266 census blocks, and is the only carrier that offers 25/3 Mbps service in 523 of the subject census blocks. There are no blocks in which the ILEC or the cable provider is the only provider offering service at 25/3 or greater. The ILEC meets this minimal level in only half of the census blocks in which Sonic operates. The table also shows that, without Sonic's fiber and UNE-based broadband services, at this level, consumers would be limited to only one option in half of these census blocks. That is, without Sonic, consumers would be able to receive 25/3 Mbps or greater service from monopoly or, at best, duopoly suppliers, a situation that economists caution can be harmful to consumers.[10] Furthermore, without Sonic, consumers in 523 census blocks would not be able to receive 25/3 Mbps service at all.

Table 4: Speed of Services Provided in Census Blocks where Sonic Operates (as of Dec. 2016)

	Blocks Served at >=25/3 Mbps	Percent of Total
Sonic Only	523	2.6%
ILEC + Sonic	82	0.4%
Cable + Sonic	9,832	48.5%
ILEC + Cable + Sonic	9,829	48.5%
Total Blocks	20,266	100.0%

Notes and sources: FCC Form 477 data, December 2016 v1. Analysis by The Brattle Group.

13. Table 5 shows the pattern of Sonic's growth as well as the deployment of fiber facilities over time (Sonic versus ILEC) in the 20,266 census blocks, from the end of 2014 through

[10] David E. M. Sappington, *Premature, Ubiquitous Forbearance Will Harm Consumers,* at 8 ("Sappington"), attached to the accompanying Opposition as Attachment 1.

the end of 2016.[11] Over this timeframe, the number of census blocks in which fiber facilities are reported to be in place grew by a factor of nearly 80: from 28 census blocks at the end of 2014 to 2,147 census blocks at the end of 2016. Sonic's deployment of fiber facilities has grown faster than that of the ILECs. The number of census blocks in which Sonic provides fiber-based internet access services has grown by a factor of nearly 50, from 25 at the end of 2015 to 1,237 at the end of 2016 (and it did not have any fiber facilities as of the end of 2014). Over the same period, the number of census blocks in which the ILECs provide fiber-based internet access services has grown from 61 to 810, or by a factor of about 13.

Table 5: Time Series of Census Blocks With Sonic and ILEC Fiber Facilities (2014-2016)

	Dec 2014	Jun 2015	Dec 2015	Jun 2016	Dec 2016
Sonic Fiber Only	0	25	184	1,009	1,237
ILEC Fiber Only	28	61	81	35	810
Sonic + ILEC Fiber	0	0	5	73	100
Total ILEC + Sonic Fiber	28	86	270	1,117	2,147

Notes and sources: FCC Form 477 data, December 2014 v2, June 2015 v3, December 2015 v2, June 2016 v2, December 2016 v1. Analysis by The Brattle Group.

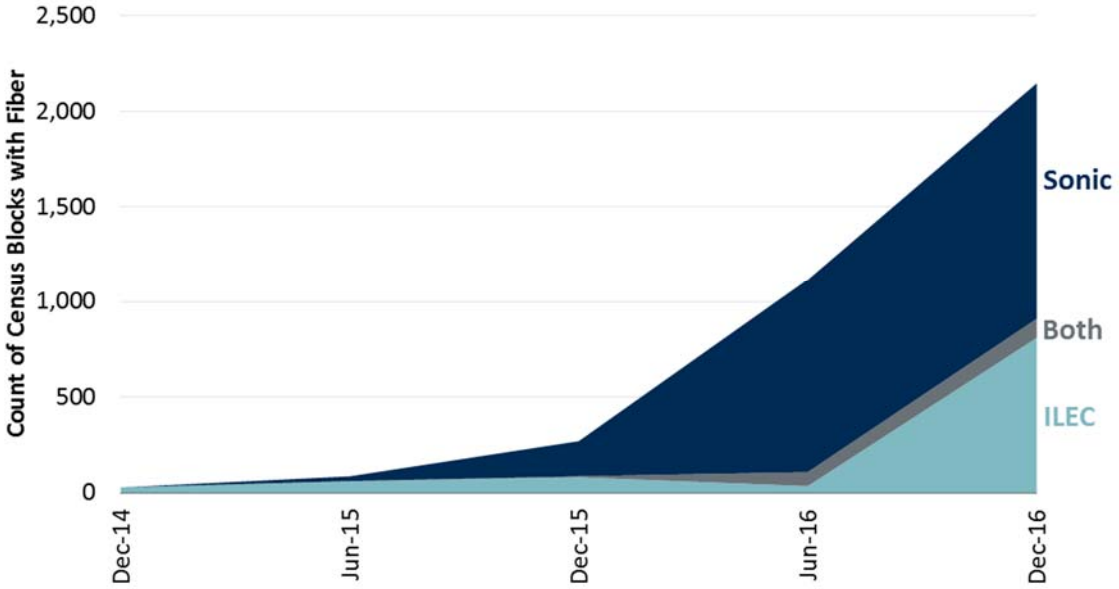
14. Table 5 shows since the end of 2015, Sonic has had more fiber facilities in place (in terms of the number of census blocks where it provides services) than the ILECs do. As of the end of 2016, the ILEC has deployed fiber facilities in 910 of the subject census blocks, while Sonic has deployed fiber in 1,337 census blocks.

15. Figure 1 shows the extent to which Sonic's fiber network has grown (in terms of number of census blocks reached). There are few areas of overlap in the deployment of fiber facilities: at the end of 2016, Sonic and the ILEC had fiber facilities in only 100 of the same census blocks, or 7% of the census blocks where ILEC or Sonic fiber facilities were present (see also Table 5). The figure shows a sharp increase in the ILEC fiber build-out in

[11] This is the timeframe covered by historical FCC 477 datasets publicly available at the time of filing (https://www.fcc.gov/general/broadband-deployment-data-fcc-form-477). It does not include subsequently deployed fiber; Sonic has deployed substantial additional fiber since December 2016. Sonic Decl. ¶ 9.

2016, which may at least in part be a response to Sonic's ongoing fiber build-out, and suggests that ILECs are following Sonic in a race to deploy fiber in these census blocks.

Figure 1: Sonic vs. ILEC Deployment of Fiber in Census Blocks where Sonic Operates (2014-2016)



Notes and sources: FCC Form 477 data, December 2014 v2, July 2015 v2, December 2015 v2, July 2016 v2, December 2016 v1. Analysis by The Brattle Group.

16. Sonic has been able to expand its fiber network because UNEs were available as a stepping stone. It is well known that the economics of broadband networks require some assurance of a customer and revenue base. Unlike the ILECs which built out their networks as monopoly providers under a rate of return regulatory regime, few if any competitive operators – including ILECs with respect to markets outside of their footprint – can afford to build-out networks on a fully speculative basis.[12] Analysis provided to the FCC as part of the BDS proceeding made it clear that a CLECs cannot profitably build-out their own networks unless there is sufficient density and it can gain sufficient market share to cover

[12] *See* M. Rysman, "Empirics of Business Data Service," WC Docket Nos 05-25, 13-5, 16-143 at 11-12 (Rev. June 2016) (only 7% of buildings were served by ILEC-affiliated CLECs on a full facilities basis), *available at*: https://docs.fcc.gov/public/attachments/DOC-340040A6.pdf.

costs.[13] CLECs like Sonic have used UNEs to gradually develop their market shares to a level which enables them to justify funding the build-out of their own networks.

17. These data support the CLECs' observations concerning the important role that UNEs play in building their own fiber networks. The presence of a third facilities-based competitor in 1,307 census blocks (see Table 1) would almost certainly not have happened if not for the availability of UNEs. For Sonic, UNEs served to effectively lower the barriers to entering facilities-based competition, and advanced the FCC's objectives of enhancing investment in broadband networks.

18. In addition, as highlighted in Professor Sappington's declaration, reliance on UNE-based services is not a viable long-term option for CLECs like Sonic – if they want to remain in business. Under existing rules, ILECs will eventually upgrade their networks to fiber and retire their copper-based networks, at least in geographic areas with moderate population densities, which will mean that bare copper UNEs will not be available for CLECs to lease indefinitely. Furthermore, the presence of fast fiber-based internet access service will make DSL-based services much less attractive to customers. As Professor Sappington has indicated, for these reasons "CLECs cannot view UNEs as a long-term substitute for their own fiber investment. Instead, they must view UNEs as a transitional means to reduce the risk associated with investment in their own fiber network."[14]

IV. CLECs are providing faster broadband speeds over the ILEC's copper network than the ILECs are themselves. In the absence of UNEs, customers either might not have access to or would have to pay much more for comparable products.

19. As indicated above, ILECs use their copper network to provide DSL in the vast majority of the 20,266 census blocks under study. DSL bandwidth speeds are determined, in part, by the equipment which is attached to the copper line over which the DSL operates. Sonic has

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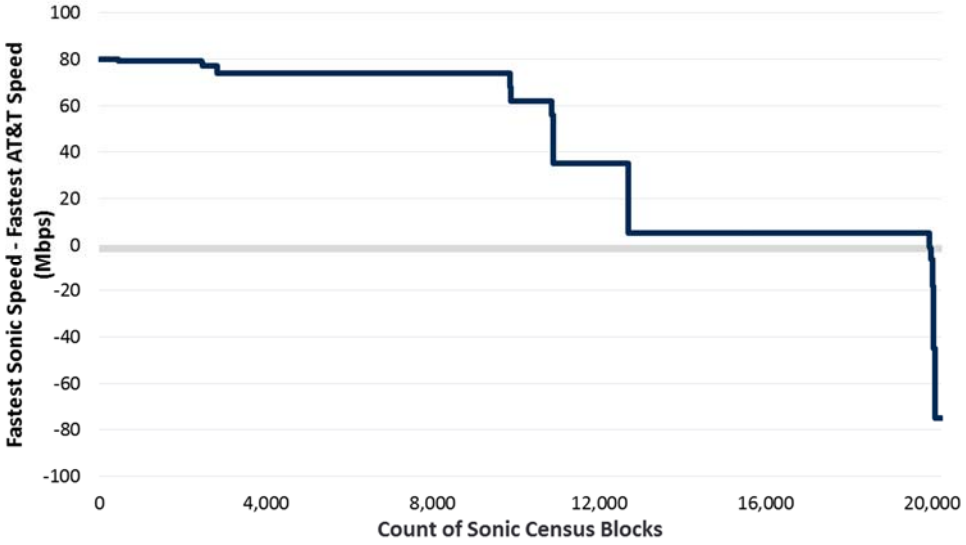
[13] CostQuest, Analysis of Fiber Deployment Economics for Efficient Provision of Competitive Service to Business Locations, Attachment A to Letter from Jennie Chandra, Windstream Corporation, to Marlene H. Dortch, Secretary, FCC, GN Docket Nos. 13-5 & 12-353, WC Docket Nos. 05-25 and 15-1, and RM-10593 (filed June 8, 2015).

[14] Sappington at 16.

demonstrated faster internet speeds than the ILECs have, in the same census blocks and over the same ILEC copper-based network.

20. We used FCC Form 477 data to compare the internet access speeds advertised by Sonic and by AT&T (the main ILEC in Sonic's service territory) for the census blocks in which Sonic operates.[15] Figure 2 makes the comparison between the fastest products available from each provider in each of the 20,266 census blocks. The figure shows the difference between internet access speeds offered by Sonic and AT&T, ranked by magnitude of the difference. Positive differences indicate that Sonic's maximum advertised product speed is faster than AT&T's, while negative differences indicate that Sonic's maximum advertised speed is slower.

Figure 2: Speed of Fastest Advertised Sonic UNE DS0 Product vs. Fastest Advertised ILEC (AT&T) Product Alternative



Notes and sources: Internet access service speeds are for the highest advertised available speed product from each provider by census block, over copper wire or via UNEs. Data from FCC Form 477, December 2016 v1. Analysis by The Brattle Group.

21. As indicated in the figure, Sonic's advertised product speed is faster than AT&T's advertised speeds in nearly all census blocks, with a difference of more than 5 Mbps in

[15] Actual speeds to which individual customers subscribe may be different than the advertised and available speeds.

approximately 63% of census blocks. Sonic explained that its product speed advantage results from the use of "bonded pairs"[16] as well as its deployment of faster DSL technologies.[17] Also, Sonic has represented that in some cases its product speeds as shown in the FCC's data may understate the actual speeds delivered to customers.

22. Sonic has also been able to provide its DSL broadband services at lower prices than AT&T. Eliminating the current UNE pricing regime would almost certainly result in an increase in the prices that Sonic would have to pay to lease these circuits. Sonic currently pays roughly $11.67 per line per month to lease UNE DS0s to provide its Sonic Fusion product to customers and two times this amount ($23.34) for bonded pairs. Sonic indicated that its next best option, if UNEs were unavailable, would be under commercial wholesale arrangements through the AT&T Partner Exchange (APEX),[18] which would cost ***BEGIN CONFIDENTIAL [redacted] END CONFIDENTIAL***.[19]

23. The increase in costs under the APEX arrangements would account for roughly ***BEGIN CONFIDENTIAL [redacted] END CONFIDENTIAL*** of Sonic's current prices for the majority of its customers.[20] Sonic would have to pass these costs onto its customers, absorb some or all of this cost increase (thereby significantly reducing its margins), or both. Such an increase in costs could effectively dismantle leasing as a stepping stone and impede the deployment of CLEC fiber networks – either by driving customers away from Sonic or by reducing Sonic's cash flow and ability to fund network investments. Under either case, consumers would be harmed.

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16 Pair-bonded service uses two copper UNEs to the premise, which serves to double the speed of the broadband connection.

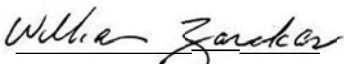
17 Sonic represented that its faster DSL speeds are also the result of its use of VDSL2 in all central office locations, and its use of ADSL2+ as a fallback when longer reach is needed. Sonic Decl. ¶ 4.

18 AT&T's wholesale product is AT&T Internet Access, available under a platform referred to as the AT&T Partner Exchange (APEX).

19 UNE DS0 rates and estimated replacement AT&T wholesale product prices were provided by Sonic.

20 Sonic represented that it currently charges residential customers between $50 and $70 per month. That is, $50 per month for its most popular "Fusion" service, plus $20 per month for faster speeds with pair bonded service. Sonic Decl. ¶ 3. The percentage of cost increases relative to Sonic prices would be less for the ***BEGIN CONFIDENTIAL [redacted] END CONFIDENTIAL*** of Sonic customers that receive service over bonded pairs.

I declare the foregoing to be true and correct to the best of my knowledge, under penalty of perjury.



William P. Zarakas

08/06/18
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William P. Zarakas is a Principal with The Brattle Group, an economics consulting firm, and an expert on economic, strategic and regulatory matters involving the energy, telecommunications and media industries. His main area of work and research involves the economics of infrastructure deployment and network development, market and competitive analysis and the alignment of regulatory frameworks with policy goals and business models. Mr. Zarakas has also led the Brattle team in analyzing the competitive and economic impacts of recent telecom and media mergers, has conducted valuations of telecom businesses and spectrum, and estimated royalties and retransmission fees in the cable and satellite television industries. He also heads Brattle's retail energy practice, which covers Brattle's work in aligning evolving utility business, and regulatory frameworks and performance based regulation.

Mr. Zarakas has provided testimony and expert reports before the Federal Communications Commission, the Federal Energy Regulatory Commission, the Securities and Exchange Commission, the Copyright Royalty Judges (Library of Congress), the U.S. Congress, state regulatory agencies, arbitration panels, foreign governments and courts of law. He has led (and authored reports concerning) special investigations on behalf of corporate boards of directors and audits of management practices and operational and financial performance on behalf of regulatory commissions. He holds an M.A. in economics from New York University and a B.A., also in economics, from the State University of New York.

Broadband Modeling and Business Planning

- Developed and authored report concerning the costs of deploying wireless broadband in rural areas. Before The Federal Communications Commission In The Matter Of Connect America Fund and Universal Service Reform – Mobility Fund. WC Docket No. 10-90 and WT Docket No. 10-208A. (February 2013, and updated analysis May 2016).
- Directed comprehensive financial analysis for a U.S .national broadband provider including: developing projections of demand, price elasticities, revenue and capital and operating costs, and pricing points.
- Performed comprehensive business case analysis of entry into the broadband market (including voice, internet access and video services) on behalf of a major U.S. electric utility. Scope of work included technology assessment and detailed financial modeling. Work included customer and geographic segmentation, pricing scenarios and elasticity analysis.
- Led comprehensive financial analysis concerning the deployment of a broadband communications network for an Asian electric utility. Related work included assessing transfer pricing methodologies regarding the use of utility assets, resources and easements by the broadband affiliate.

- Directed and led analysis of business diversification for multiple electric utilities. Business opportunities analyzed included dark fiber construction and third party use of utility poles, towers and conduit. Scope of analysis included financial modeling and transfer pricing.

Competition Analysis

- Directed comprehensive analysis and provided testimony concerning market shares, vertical foreclosure and Nash bargaining in the Application of Comcast Corporation, General Electric Company and NBC Universal, Inc. for Comcast to Assign or Transfer Control of Licenses, Before the Federal Communications Commission, MB Docket No. 10-56. (December 2014 and March 2015).
- Led analysis and provided testimony concerning the merger of TECO Energy, New Mexico Gas Company, and Continental Energy Systems, Before the Public Regulation Commission Utility Case No. 13-00231-UT (March 2014).
- Directed analysis and authored report regarding the effects of changes in regulatory fees and taxes on mobile prices, penetration and the macro economies of 22 countries in the Middle East and Africa. Study, conducted on behalf of a major mobile operator, involved detailed analysis of the relationships between marginal cost and prices, market structure and concentration, and empirical relationships concerning mobile penetration and GDP.
- Led analysis and authored expert reports concerning prospective merger savings and divestiture losses for electric and gas utilities. Scope of work included analyses involved in determining the operating and capital impacts of mergers under multiple scenarios, and also involved the anticipated economic inefficiencies resulting from forced divestiture. Reports authored included studies of merger efficiencies and reports concerning Economic Loss Studies included in U-1 filings before the U.S. Securities and Exchange Commission. Economic Loss Studies are required under PUHCA Section 11 (b) (1) Clauses A, B, and C when utility merger results in the establishment of a registered holding company with electric and gas businesses. Work in these areas included detailed analyses of current and hypothetical future electric and gas utility operations.

Spectrum Valuations

- Conducted analyses and authored expert report estimating value of Mobile Satellite Service (MSS) spectrum (i.e., the 2 GHz Band from 2000-2020 MHz and 2180-2200 MHz, the Big LEO from 1610-1626.5 MHz and 2483.5-2500 MHz, and the L-band from 1525-1559 MHz and 1626.5-1660.5 MHz) in several matters, including matters involving the Terrestar

bankruptcy. Analyses included impact of incorporating FCC authorized ancillary terrestrial component (ATC) into MSS mobile broadband networks.

- Analyzed spectrum values in the 2.3 and 2.5 GHz bands for the U.S. market.
- Analyzed value of Advanced Wireless Services (AWS; 1.7 / 2.1 GHz) band for the U.S. market.
- Analyzed value of unpaired 2.1 GHz spectrum for the U.S. market.
- Analyzed value of 2.3 GHz (WCS) 3.5 GHz (FWA) spectrum in Canadian market.
- Authored report concerning market comparable analysis of U.S. PCS market.
- Provided expert testimony concerning potential value of wireless spectrum in the 700 MHz band.
- Analyzed value of Specialized Mobile Radio (SMR) and Private Land Mobile Radio Services (PLMRS) spectrum on behalf of utility operating companies in the U.S. market.
- Analyzed value of narrowband PCS and IVDS spectrum portfolio.
- Directed, led analysis and authored report concerning valuations of wireless spectrum in the Middle East-North African (MENA) region for an international wireless operator.
- Directed, led analysis and authored report concerning impact of additional wireless operators on spectrum values for the telecommunications regulator in the Kingdom of Jordan.

Utility Business Models and Investment Analysis

- Advised New York's Reforming the Energy Vision (REV) architects (i.e., the NYPSC chair and NYSERDA leads) on implementation and utility transformation issues. Led comprehensive modeling and scenario analysis concerning the impact of distributed energy resources (DERs) on utility sales, revenues, capital and operating cost structures and financing, and on utility rate base and customer rates and bills. Project also involved developing scenarios for energy and related service based transactions occurring over a utility platform and the most appropriate scope of a platform in the near term.
- Modeled and advised New York's six investor owned utilities on matters relating to regulatory incentive structures. The New York REV created earnings adjustment mechanisms (EAMs) intended to provide a bridge from the traditional regulatory model to a (still evolving) next generation model. The State's utilities are responsible for specifying the new EAMs. Brattle worked with the utilities to design EAMs and also conducted scenario

analysis that projected likely outcomes in key REV areas (e.g., peak reduction, asset utilization and integration of DERs).

- Led strategic analysis of next generation (i.e., utility of the future) regulatory frameworks for a Midwestern electric utility. Specifically, Brattle was asked to opine on the future of utility platforms (highly transactive two-sided markets vs. less transactive / more informational) recommend the appropriate regulatory framework for the near to intermediate term. Brattle's analysis included a review of DER feasibilities and transactive platform requirements. It also included a comprehensive assessment of regulatory incentive frameworks, including performance based regulation and the U.K.'s RIIO model.
- Led system reliability and resilience investment analysis for a large combination electric and gas utility. Customer concern (and political pressure) following a series of weather-induced large scale and long duration outages led to the utility developing an extensive and relatively expensive resilience investment program. Brattle advised the company on benefits and costs, and employed a value of lost load (VOLL) methodology to estimate customer willingness to pay for higher reliability in extreme circumstances. The company modified the scope of its investment program accordingly. Brattle analysis and reports were also included in the company's regulatory filings. (Public Service Electric & Gas (PSE&G) in NJ BPU Docket No. EO13020155 and GO13020156)
- Advised board of trustees and executive management on strategic and organizational direction for the Long Island Power Authority (LIPA). LIPA assumed a municipal corporate structure following the decommissioning of a nuclear power plant. The utility had among the highest rates in the U.S. and the lowest customer approval ratings. Brattle was retained to advise the utility and the Governor's office on ways to improve cost structure (e.g., through privatization, municipalization and outsourced management services arrangements) and ways to better understand and meet customer needs (e.g., community energy programs and resilience improvements). Options were evaluated based on rate impacts and risk factors, including risks associated with organizational transformation. Project required extensive modeling of LIPA operations and financing scenarios, as well as analysis of power and transmission markets.
- Advised board of directors of a major generation and transmission (G&T) cooperative and its member electric distribution cooperatives on matters concerning: asset valuations, risk management strategy, merger and acquisition options, and outlook for retail electric markets.

Cost, Rate and Incentive Analyses

- Led analysis and authored report and testimony concerning the specifications, targets and incentive structure for performance regulatory measures for use by the Hawaiian Electric Companies. Before the Public Utilities Commission of the State of Hawaii, In The Matter of Public Utilities Commission Instituting an Investigation to Reexamine the Existing Decoupling Mechanisms Docket No. 2013-104. September 15, 2014
- Led analysis and authored report and testimony concerning incentive regulatory frameworks and targeted performance incentives for electric and natural gas utilities in Massachusetts. Massachusetts D.P.U. 12-120. March 2013.
- Led and authored report concerning comprehensive analysis of approaches to setting electric distribution reliability standards on behalf of the Australian Energy Market Commission (AEMC).
- Directed and provided expert testimony on price cap frameworks and productivity analysis applied to telecommunications business data services (BDS, previously referred to as special access) in proceedings before the U.S. Federal Communications Commission. WC Docket No. 16-143, WC Docket No. 15-247, WC Docket No. 05-25, RM-10593.
- Directed and provided testimony concerning pole Attachment rates in Virginia Cable Telecommunications Association v. Virginia Electric and Power (December 21, 2001) and FCC Docket No. 15-90, File No. EB-15-MD-006 (November 18, 2015).
- Analyzed costs and value of retransmitted television programming in cable and satellite video markets and determined distribution of copyright royalty fees among content providers. Authored expert report Before The Copyright Royalty Judges, Library of Congress, Washington D.C. In The Matter of Distribution of the 2004 and 2005 Cable Royalty Funds, Docket No. 2007-3 CRB CD 2004-20. June 1, 2009
- Directed comprehensive modeling and analysis and provided testimony in multiple U.S. state regulatory proceedings concerning analysis of rates for unbundled network elements (UNEs), undertaken in fulfillment of requirements associated with the Telecommunications Act of 1996, using the Total Element Long Run Incremental Cost (TELRIC) methodology.
- Led analysis and provided testimony concerning incentive systems to be applied to incumbent local exchange telephone carriers (ILECs) on behalf of the New York State Department of Public Service; involved modeling determining total factor productivity (TFP)

based on empirical analysis and consideration of projected performance improvement initiatives.

- Conducted cost-of-service and marginal cost analyses for an international broadband company spanning the U.S., European and Asian markets.
- Directed cost of service and feasibility analysis for a municipality planning on deploying a broadband Wi-Fi network.
- Directed analysis and authored white paper on empirical analysis concerning the impact of changing the price of wholesale access and levels of investment in the U.S. telecommunications market. Results reported in white paper entitled: "Structural Simulation of Facility Sharing: Unbundling Policies and Investment Strategy in Local Exchange Markets."

Arbitration, Special Investigations and Commercial Litigation

- International Arbitration (satellite communications): Authored expert report concerning the impact of an alleged breach of contract on lost profits in a 23 country business operation concerning a satellite communications business. Performed detailed financial modeling to determine revenues, net income and net present value using risk adjusted discount rates for a satellite service provider.
- Forensic Analysis and Special Investigation: Directed consulting team and authored report for the forensic analysis of the economics, financial reporting and accounting associated with allegation of accounting and financial improprieties by Global Crossing. Worked on behalf of the Special Committee on Accounting Matters composed of a subset of (and reporting to) the Board of Directors of Global Crossing Ltd. Analysis involved determination of basis for revenue recognition for concurrent (i.e., "swap") transactions. Analysis included in report by the Special Committee entitled "The Concurrent Exchange of Fiber Optic Capacity and Services Between Global Crossing and its Carrier Customers." January 2003.
- Commercial Litigation: Directed expert consulting team in litigation matter concerning the deployment schedule of bandwidth on a major undersea cable project. Case involved allegations of breach of contract. Case work involved modeling of undersea fiber optic bandwidth in major undersea crossings and financial analysis of project viability.
- Forensic Analysis and Securities Litigation: Directed consulting team and led technical analysis concerning accounting and financial disclosure on behalf of the defendant in a class action against corporate officers, directors, controlling shareholders and the company's

outside auditors alleging violations of the Securities Act of 1993 and the Securities Exchange Act of 1934. Scope of case involved accounting and disclosure treatment of complex leases.

- Special Investigations and Audits: Directed project teams, led technical analysis and authored reports in multiple special investigations and audits of management, operations and finance and accounting on behalf of regulatory utility commissions. Special investigations and audits involved allegations of improper cross subsidization and/or transfer pricing practices by regulated utilities (telecommunications, electric and/or natural gas) and their effect on rates charged to consumers. Special investigations and audits were conducted for regulatory commissions in Alabama, Kentucky, Maryland, New York and Pennsylvania.
- Commercial Litigation (broadband communications): Provided expert testimony concerning the estimate of commercial damages stemming from an alleged breach of contract associated with relocating infrastructure assets. Public Service Company of New Mexico vs. Smith Bagley, Inc. and Lite Wave Communications LLC In The United States District Court For The District of New Mexico. March 2007.
- Commercial Litigation (wireline communications): Developed analysis and supported expert testimony concerning damages associated with cable breaks and disruption of wholesale transport services. Analysis involved estimating lost profits and determining replacement cost of temporarily lost capacity. MCI WorldCom Network Services, Inc. v. MasTec, Inc. before the United States District Court Southern District of Florida, Case No. 01-2059-CIV-GOLD. May 2002.

TESTIMONY

Declaration of William Zarakas and Eliana Garces In the Matter of beIN Sports, LLC, Complainant,v. Comcast Cable Comunications, LLC and Comcast Corporation, Defendants, MB Docket No. 18-90.

Declaration (August 7, 2017) and Reply Declaration (August 29, 2017) of William P. Zarakas and Jeremy A. Verlinda Before the Federal Communications Commission In the Matter of Tribune Media Company (Transferor) and Sinclair Broadcast Group, Inc. (Transferee), Consolidated Applications for Consent to Transfer Control, MB Docket No. 17-179

Declaration of William P. Zarakas Before the Federal Communications Commission In the Matter of Business Data Services in an Internet Protocol Environment, Investigation of Certain Price Cap Local Exchange Carrier Business Data Services Tariff Pricing Plans, Special Access for Price Cap Local Exchange Carriers, AT&T Corporation Petition for Rulemaking to Reform Regulation of Incumbent Local Exchange Carrier Rates for Interstate Special Access Services, WC Docket No. 16-143, WC Docket No. 15-247, WC Docket No. 05-25, RM-10593. Declaration of William P. Zarakas and Susan M. Gately

(January 27, 2016); Supplemental Declaration of William P. Zarakas (March 24, 2016); Declaration of William P. Zarakas and Jeremy Verlinda (June 28, 2016, Attachment D to Comments of Sprint Corporation); Declaration of David E. M. Sappington and William P. Zarakas (June 28, 2016, Attachment E to Comments of Sprint Corporation); Further Supplemental Declaration of William P. Zarakas (August 9, 2016, Attachment A of Reply Comments of Sprint Corporation).

Declaration of William P. Zarakas Before the Federal Communications Commission In the Matter of Verizon Virginia. LLC and Verizon South, Inc., Complainants, v. Virginia Electric and Power Company d/b/a Dominion Virginia Power, Docket No. 15-90, File No. EB-15-MD-006 (November 18, 2015).

Declaration of William P. Zarakas and Matthew Aharonian (May 22, 2015) in the United States Court for the District of Columbia Circuit United States Telecom Association, Petitioner, v. Federal Communications Commission and the United States of America, Respondents, Case No. 15-1063 (and consolidated cases).

Declarations Before the Before the Federal Communications Commission In the Matter of Application of Comcast Corporation, General Electric Company and NBC Universal, Inc. for Comcast to Assign or Transfer Control of Licenses, Federal Communications Commission, MB Docket No. 10-56. Analysis of the FCC's Vertical Foreclosure and Nash Bargaining Models Applied To The Proposed Comcast-Time Warner Cable Transaction (December 21, 2014) and Supplemental Declaration: Analysis of the FCC's Vertical Foreclosure and Nash Bargaining Models Applied To The Proposed Comcast-Time Warner Cable Transaction (March 5, 2015).

Before the Public Utilities Commission of the State of Hawaii, In The Matter of Public Utilities Commission Instituting an Investigation to Reexamine the Existing Decoupling Mechanisms for Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc., and Maui Electric Company, Limited, Docket No. 2013-1041, On Behalf of the Hawaiian Electric Companies. Report: "Targeted Performance Incentives: Recommendations to the Hawaiian Electric Companies," Prepared For The Hawaiian Electric Companies, William P. Zarakas and Philip Q Hanser, September 15, 2014.

Before the New Mexico Public Regulatory Commission, In The Matter Of The Application of TECO Energy, Inc., New Mexico Gas Company, Inc. and Continental Energy Systems, LLC, For Approval of TECO Energy Inc.'s Acquisition of New Mexico Gas Intermediate, Inc. and For All Other Approvals and Authorizations Required To Consummate and Implement The Acquisition, Utility Case No. 13-00231-UT, On Behalf of TECO Energy, Inc., New Mexico Gas Company, Inc. and Continental Energy Systems, LLC, Joint Applicants. March 2014.

Before the New Jersey Board of Public Utilities In the Matter of the Petition of Public Service Electric and Gas Company for Approval of the Energy Strong Program, expert report, "Analysis of Benefits: PSE&G's Energy Strong Program," by Peter Fox-Penner and William P. Zarakas. NJ BPU Docket No. EO13020155 and GO13020156. October 7, 2013.

"Review and Analysis of Service Quality Plan Structure In The Massachusetts Department of Public Utilities Investigation Regarding Service Quality Guidelines For Electric Distribution Companies and

Local Gas Distribution Companies." Philip Q Hanser, David E. M. Sappington and William P. Zarakas, Massachusetts D.P.U. 12-120, March 2013.

"Alaska Mobile Broadband Cost Model, Before The Federal Communications Commission In The Matter Of Connect America Fund and Universal Service Reform – Mobility Fund. WC Docket No. 10-90 and WT Docket No. 10-208A." William P. Zarakas and Giulia McHenry, February 2013

Expert Report of William P. Zarakas In The United States District Court For The Northern District of Florida MCI Communications Services, Inc., Plaintiff v. Murphree Bridge Corporation, Defendant, Case No. 5:09-cv-337, February 19, 2010.

Testimony of William P. Zarakas Before The Copyright Royalty Judges, Library of Congress, Washington D.C. In The Matter of Distribution of the 2004 and 2005 Cable Royalty Funds, Docket No. 2007-3 CRB CD 2004-20. June 1, 2009.

Declaration of William P. Zarakas In The Circuit Court of Fairfax County, Virginia In The Matter of Sharon Dougherty, Plaintiff Vs. Thomas J. Dougherty, Defendant Case No. CL 2007-008757. October 2008.

Expert report provided in Public Service Company of New Mexico vs. Smith Bagley, Inc. and Lite Wave Communications LLC In The United States District Court For The District of New Mexico. March 2007.

Expert report entitled "Comparative Market Value Analysis of Upper 700 MHz Public Safety Spectrum" in FCC WT Docket no. 96-86 (In the Matter of The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010). June 2006.

Expert report entitled "Analysis of Potential Lost Profits Associated With The Alleged Breach of Contract Between Orbcomm and Orbcomm Asia Limited" before the American Arbitration Association. May 2006.

Direct testimony before the Federal Communications Commission in the matter of *Petition of ACS of Anchorage, Inc. Pursuant to Section 10 of the Communications Act of 1934, as amended, for Forbearance from Sections 251(c)(3) and 251(d)(1) In the Anchorage LEC Study Area*, WC Docket No. 05-281, January 9, 2006.

Expert report co-authored with Dorothy Robyn Before the U.S. House of Representatives Committee on Energy and Commerce and the U.S. Senate Committee on Commerce, Science and Transportation regarding the value of wireless spectrum in the 700 MHz band. Letters, May 18, 2005.

Direct and rebuttal testimony before the Federal Communications Commission in the matter of *Virginia Cable Telecommunications Association v. Virginia Electric and Power Company, d/b/a Dominion Virginia Power and Dominion North Carolina Power*, PA No. 01-005, December 21, 2001.

Expert report Before the U.S. Securities and Exchange Commission included in Form U-1 Application/ Declaration Under The Public Utility Holding Company Act of 1935 in the combination of Energy East Corporation with RGS Energy Group, Inc. (June 20, 2001) in Exhibit J-1, entitled "Analysis Of The Economic Impact Of A Divestiture Of The Gas Operations Of Rochester Gas And Electric Corporation," May 15, 2001.

Expert report Before the U.S. Securities and Exchange Commission included in Form U-1 Application/ Declaration Under The Public Utility Holding Company Act of 1935 in the acquisition by Sierra Pacific Resources of Portland General Electric Company, 2000 in Exhibit H-1, entitled "Analysis Of The Economic Impact Of A Divestiture Of The Gas Operations Of Sierra Pacific Resources," January 31, 2000.

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Before the Supreme Court of the State of New York, County of Niagara, Supplemental Affidavit in *Village of Bergen, et al. vs. Power Authority of the State of New York*, February 1999.

Rebuttal Panel Testimony of William P. Zarakas and D. Daonne Caldwell before the North Carolina Utilities Commission, Docket No. P-100, SUB 133D, Filed March 9, 1998; *In Re: Proceeding to Determine Permanent Pricing for Unbundled Network Elements*.

Direct Panel Testimony of William P. Zarakas and D. Daonne Caldwell before the North Carolina Utilities Commission, Docket No. P-100, SUB 133D, Filed December 15, 1997; *In Re: Proceeding to Determine Permanent Pricing for Unbundled Network Elements*.

Rebuttal Panel Testimony of William P. Zarakas and D. Daonne Caldwell before the South Carolina Public Service Commission, Docket No. 97-374-C, Filed November 25, 1997; *In Re: Proceeding to Review BellSouth Telecommunications, Inc.'s Cost Studies for Unbundled Network Elements*.

Direct Panel Testimony of William P. Zarakas and D. Daonne Caldwell before the Florida Public Service Commission, Docket Nos. 960757-TP/960833-TP/960846-TP/960916-TP/971140-TP, Filed November 13, 1997; *In Re: Petition of AT&T, MCI, and MFS for Arbitration with BellSouth Concerning Interconnection, Rates, Terms and Conditions of a Proposed Agreement*.

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Rebuttal Panel Testimony of William P. Zarakas and D. Daonne Caldwell before the Alabama Public Service Commission, Docket No. 26029, Filed September 12, 1997; *In Re: Generic Proceeding: Consideration of TELRIC Studies*.

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